Case Study

Nephropathy in Chronic Lead Poisoning

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This case is that of a 43 year-old male who had worked at a secondary lead smelter for 14 years. Lead poisoning was suspected at a statutory health check in 1991. After the diagnosis, he received regular health checks twice each year. In 1993, he felt pain in both extremities and altered sensation but was not treated. Later he was admitted for lead poisoning and received CaNa₂EDTA (edetate calcium disodium) for 5 days. Early in 1994 he complained of redness and pain in the right great toe and was treated for gout. At one of his regular health checks, his blood lead concentration was found to be 180 µg/dl. He was therefore admitted from July 11 to 20, 1994.

There was no history of tuberculosis, diabetes mellitus or hepatitis. Hypertension was diagnosed 3 years previously and treated intermittently.

His previous work included farming and lead related industries. He was a foreman and his other job was transporting lead ingots. In the course of his work, lead dust was scattered about but he usually did not use personal protective equipment such as a mask. He reported smoking 20 cigarettes per week and drinking one bottle of Soju (National Drink, 25% alcohol, 360 ml) per day. He had decreased his alcohol consumption prior to admission.

He was 166 cm tall and weighed 71 kg. His blood pressure was 160/90 mmHg on admission and there were no noticeable findings except redness over the right metatarsal joint area. In liver function tests, alanine aminotransferase/aspartate aminotransferase were in the normal range, but gamma-glutamyl transferase was very high, 456 IU/l. The blood film showed a hypochromic, microcytic picture,

with basophilic stippling. Chest PA was normal, and abdominal ultrasound suggested a fatty liver. The electrocardiogram and funduscopy were normal. The profile of lead exposure indices showed evidence of lead poisoning (PbB 83.0 µg/dl, PbU 28.3 µg/l, ZPP 300.0 µg/dl, δ-ALAD 2.2 µmol ALA/min/l RBC and δ-ALAU 2.2 mg/l).

Renal function test reflected severe renal impairment with very low creatinine clearance (31.9

Fig. 1. Global sclerosis of glomerulus in kidney by H & E stain.

Fig. 2. Interstitial fibrosis of renal tissue by Masson-trichrome stain.

Fig. 3. Diffuse loss of the brush border in the proximal tubule by electron microscopy.

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ml/min) and high urinary protein (urinary albumin 100.0 mg/g creatinine, urinary α 1-microglobulin 120.5 mg/g creatinine and urinary β 2-microglobulin 183.8 μ g/g creatinine).

The ultrasonography-guided renal biopsy showed global sclerosis of glomeruli (Fig. 1), moderate atrophy and loss of tubules, and interstitial fibrosis on light microscopy (Fig. 2). Electron microscopy showed diffuse loss of the brush border in the proximal tubule (Fig. 3).

Discussion

This patient had chronic lead poisoning which was supported by an overt occupational history, laboratory findings and medical records including a history of gout and hypertension.

The functional disturbance, described by Rossi and Crepet *et al.*,⁴⁾ is a striking diminution of renal perfusion flow with a modest reduction in the glomerular filtration rate. Endo *et al.*⁵⁾ found increasing urinary α 1-microglobulin and β 2-microglobulin in renal impairment due to chronic lead exposure. In this case, renal impairment was shown by laboratory findings.

In acute poisoning, these changes, such as intranuclear inclusion bodies of lead and morphological changes in mitochondria, are reversible⁶⁾. Intranuclear inclusion bodies are lead-protein complexes resulting from attempts to separate lead in the renal cells. This is accompanied by aminoaciduria, glycosuria and hyperphosphaturia (as in Fanconi syndrome). After this stage, the capacity for formation of cellular intranuclear inclusion bodies is diminished, renal excretion of lead decreases and blood uric acid increases. Consequently, high uric acid in blood occurs but Fanconi syndrome ceases. In chronic lead poisoning, interstitial fibrosis, tubular atrophy and dilatation and arteriosclerotic changes are irreversible⁷⁾. Our biopsy findings were of global glomerular sclerosis with fibrosis, and of atrophy with loss of tubules and interstitium. These all support a diagnosis of nephropathy due to chronic lead poisoning.

The terminal stage of renal impairment due to lead exposure is accompanied by hypertension, high urinary uric acid, hyperkalemia and gout. Garrod⁸⁾ noted a high incidence of gout among painters and workers in the lead trades and Lorimer⁹⁾ investigated 108 cases of gout and found several clinical features of saturnine gout to distinguish it from ordinary gout. Emmerson and Thiele¹⁰⁾ reported 35

cases of saturnine gout found in a group of 62 patients with lead nephropathy. Our case also had 9.1 mg/dl of blood uric acid at admission and complained of redness and pain in the metatarsal joint of the right great toe. He had been treated for gout for 3 months.

In our case report, renal damage, hypertension and lead exposure are associated in the same person. Lead exposure without identified renal damage has been described in association with hypertension¹¹⁾. Weiss *et al.*¹²⁾ suggested mechanisms for a direct effect of lead exposure on blood pressure through calcium metabolism. In our case report, the degree of hypertension (including ECG and fundoscopic findings) was insufficient to account for the renal changes identified. Neither were biopsy findings suggestive of hypertensive renal disease. It is not clear whether chronic lead poisoning was a direct cause of hypertension in the case which we report. The relationship between hypertension, lead exposure and lead poisoning is therefore an important area for study.

References

- 1) Lilis R, Dumitriu C, Roventa A, Nestorescu B, Pilat L. Renal function in chronic lead poisoning. *Med Lav* 1967; 58: 506-512.
- 2) Cooper WC, Gaffey WR. Mortality of lead workers. *J Occup Med* 1975; 17: 100-113.
- 3) Wedeen RP. *Poison in the Pot*. Carbondale: Southern Illinois Press, 1984.
- 4) Crepet M, Gobbato F, Martinio P, Siracusa F. La nefropatia saturnina. *Minerva Nefrol* 1959; 3: 69.
- 5) Endo G, Konishi Y, Kiyota A, Horiguchi S. Urinary α 1-microglobulin in lead workers. *Bull Environ Contam Toxicol* 1993; 50: 744.
- 6) Cramer K, Goyer RA, Jagenburg R, Wilson MH. Renal ultrastructure, renal function, and parameter of lead toxicity in workers with different periods of lead exposure. *Br J Ind Med* 1974; 31: 113-127.
- 7) Goyer RA. Lead and the kidney. *Curr Top Pathol* 1971; 55: 147-176.
- 8) Garrod AB. Second communication on the blood and effused fluids in gout, rheumatism and Bright's disease. *Med Chir Trans (London)* 1854; 37: 49-53.
- 9) Lorimer G. Saturnine gout, and its distinguishing marks. *Br Med J* 1886; 2: 163.
- 10) Emmerson BT, Thiele BR. Calcium versenate in the diagnosis of chronic lead nephropathy. *Med J Aust* 1960; 1: 243-248.
- 11) Kirkby H, Gyntelberg F. Blood pressure and other cardiovascular risk factors of long-term exposure to lead. *Scand J Work Environ Health* 1985; 11: 15-19.
- 12) Weiss ST, Munoz A, Stein A, Sparrow D, Speizer FE. The relationship of blood lead to blood pressure in longitudinal study of working men. *Am J Epidemiol* 1986; 123: 800-804.